

Notwithstanding the opportunities which Japan offers to make such investigations, it is worthy of note that two trained men were ordered by the Government of that country to report upon the recent earthquake in Assam. This they have done, and no doubt Japan is now in a position to avoid forms of construction of which she was hitherto without experience.

J. MILNE.

(To be continued).

PROF. PICKERING has conceived and carried to a successful issue many projects that require both mechanical skill and confidence in his resources. In the gradual development of these schemes, we have seen the modest row of volumes, that contained the annals of the Harvard Observatory prior to his directorate, increase to imposing proportions. We know how deftly he holds the strings that control the operations of many departments outside Harvard, and how efficiently he copes with the work that a whole army of astronomers submits to his examination. But assuredly the equipment and maintenance of the observatory at Arequipa will be remembered as one of his most successful achievements. We are apt to think of a subsidiary observatory, especially when situated in a position difficult of access, as one temporarily occupied for a definite purpose, and requiring but few instruments, mounted in buildings of slight construction. But the energy of Prof. Pickering has established in South America an observatory that a State government, having the resources of a public exchequer at its will, might look upon with satisfaction. We reproduce in Fig. 1 (p. 250) the general appearance of this astronomical station, some 8000 feet above the level of the sea, and a mere glance will show or suggest how varied must be the work of the observatory, in which all the telescopes under the different sheds are kept constantly employed through every clear night. In the illustration the observer's residence is on the extreme right. Starting from that point and taking the several buildings in order as we approach the left, we have first of all a laboratory with developing rooms attached, next a shed containing a 5-inch visual telescope, which leads on to another containing a 20-inch mirror of short focal length, figured by Dr. Common for the observation of the solar eclipse of 1889. We then pass a building containing the principal clocks and a transit instrument, and come to that containing the Bache telescope of eight inches aperture. Next to this is the 13-inch Boyden telescope under a cylindrical drum roof. To the left of this, and before we come to the buildings occupied by the assistants, is a telescope with a Voigtlander portrait lens as an objective in which are taken photographs of four hours' exposure of faint

We shall get a good idea of the use to which these instruments are put if we describe some of the illustrations that Prof. Pickering has given in the volume containing the "Miscellaneous Investigations of the Henry Draper Memorial." We have first of all a picture of the Southern Cross on which abuts a portion of Herschel's Coal-sack region, taken with the Bache telescope, exposure 127 minutes, covering an area ten degrees square. We might make this plate the excuse for discussing several points of great interest. First, should photographs represent

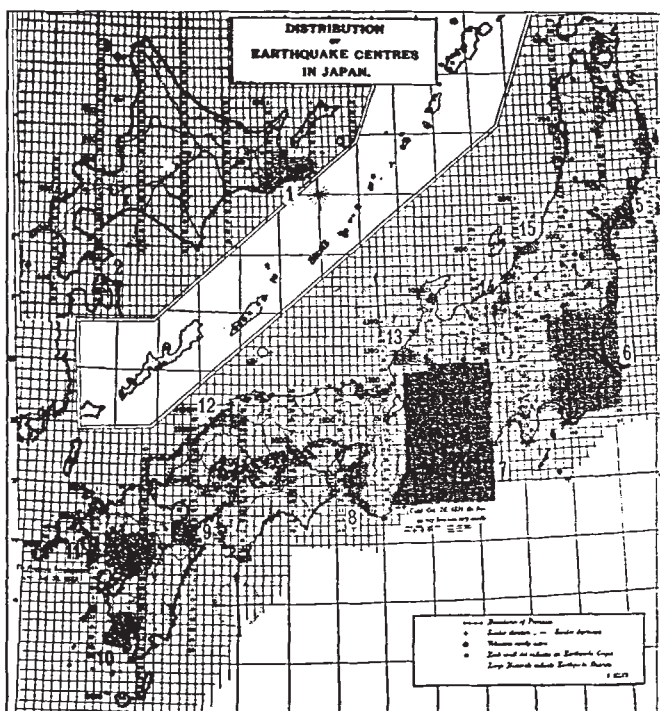


FIG. 6.—Map showing the origins of 8331 shocks recorded between 1885 and 1892 in Japan. The large dots indicate the positions of active volcanoes. The small dots indicate the origin of different earthquakes which group themselves into fifteen districts, each marked by a large numeral. (Milne.)

the stars on paper as positives or negatives? Prof. Pickering, by his practice, is clearly in favour of exhibiting the stars as black dots on a white ground. In this decision he has been guided by the use of ordinary star charts, in which there has never been any question as to the most convenient method of representing stars, and to which astronomers have already accommodated themselves. With regard to the important question of the scale to be adopted, and which in this telescope gives three minutes to the millimetre, it will be admitted that it is too small for star charts, if faint stars are to be represented. Prof. Pickering says distinctly that the images are too near together to be conveniently studied. It is mainly for this reason that we do not reproduce the plate, which would have been interesting since it affords a good illustration of the difference between photographic and visual magnitudes. γ Crucis, which has a spectrum

of the third type and is very red in colour, appears on the print much fainter than δ , while ϵ Crucis, also a third type spectrum star, which to the eye is so conspicuous that it is usually inserted in rough diagrams of the constellation, as for example on the Brazilian postage-stamps, is on the negative so faint, that it would not be selected as one of the principal stars.

The trifold nebula in Sagittarius, taken with the same telescope and exposure, illustrates still more completely the inadequacy of this scale for star maps, but brings out well the structure of such portions of the Milky Way as fall on the plate. This particular region is remarkable for the number of gaseous nebulae that fall within the area covered by the plate. One-tenth of the whole number hitherto discovered in all parts of the sky are here depicted; but almost every night increases the number of these objects in our catalogues. The examination of only two plates taken with the Bruce telescope and objective prism showed that the spectra of six known nebulae were gaseous. We pass over

There seems to be no doubt about the place of the nebulae so described, as a curved line of stars noticed by Herschel is recognisable. But of the nebula itself there is no trace. One seems to have another instance of variability similar to Hind's nebula in Taurus. The spectra of the stars contained in this portion of the sky is also illustrated. By placing a prism in front of the objective of the Bache telescope and exposing for 140 minutes, we have, exhibited on one plate, more than 1000 spectra. Where the stars are densest the separate spectra cannot be recognised in the print, but on the original negative even these can be conveniently classified. No less than fourteen stars within this limited area, out of a total of sixty-three already catalogued, show a spectrum which consists mainly of bright lines.

The cluster known as ω Centauri is admittedly the finest in the sky. We reproduce, in Fig. 2, a reduced form of the illustration of this superb object as it depicts itself in the Boyden telescope after two hours' exposure. In one particular this picture fails to do justice to the



FIG. 1.—Arequipa Station from the south-west.

the photographs of the Magellanic clouds, reproduced in the volume by contact printing, and reach the nebulous region round η Argus, or as Prof. Pickering prefers to call it η Carinae. This has been the subject of so many illustrations that its main features are well known. It serves here as an admirable object on which to test the advantages of increased scale. Three different enlargements of the original negative are given, one taken with the Boyden telescope. Prof. Pickering apparently prefers a scale of ten seconds to the millimetre at least for districts where the stars are much crowded. This size seems to him to possess the advantage of showing nearly all the stars that can be seen upon the original negative, without rendering the images inconveniently large. On a careful comparison being made between the nebulae recorded on the plate and those given in Dreyer's catalogue one very important difference was noted. N.G.C. 3199 was observed by Herschel on four nights, and on each occasion described by him as very large and bright.

original in the sky. The photographic images have sensible diameters amounting to, perhaps, three seconds of arc. This suggests the possibility that some stars are hidden by those nearer to us, but, as Prof. Pickering remarks, in the telescope each separate star can be distinguished, and therefore it is not probable that any star is actually occulted. The only two other clusters in the sky, which though far behind, are to some extent comparable with ω Centauri in brilliancy, are 47 Tucanae, and the well-known cluster in Hercules, Messier 13. In each of these clusters Prof. Bailey and the staff have made attempts to count the number of stars visible, and Prof. Pickering has submitted the results to a mathematical analysis. He finds that the number of stars per square minute of arc increases in arithmetical progression as the centre is approached, and that the theoretical number derived from his formula agrees fairly well with the actual count. In the case of ω Centauri the number actually counted was 6336, while

theory gives 6475. The stars in the cluster 47 Tucanæ are divided into bright and faint stars. The number of each counted is 1495 and 740 respectively, while theory gives 1495 and 734. We, in the Northern Hemisphere, think Messier 13 a magnificent object, but the number of stars counted is only 723, while theory assigns one more. It says much for the admirable character of the photographs that, notwithstanding the closeness of the stars and the consequent tendency for the individual members to be obscured by the spread of the images, it should be possible to count the stars with approximate accuracy. And further, the individual stars are so distinct that variations of brilliancy are easily recognised. In this way no less than eight new variable stars have been detected in the cluster of ω Centauri, while six have also been discovered in the south following portions of the cluster 47 Tucanæ. The occurrence of a large proportion of variable stars in star clusters is a most interesting subject of inquiry. Counts have been made of the number and distribution of stars in several clusters, with the result that 400 were found in these objects. Nearly 7000 estimates were made of the brightness of the 120 variables contained in ω Centauri, and of the eighty-five variables in Messier 5.

It might be thought from this short summary that Prof. Pickering is interesting himself mainly in these very interesting objects. It must be remembered, however, that they come naturally before him in the course of a complete survey of the whole heavens, and that while we have referred to only a few plates, the entire scheme had on January 1, 1895, resulted in the collection of no less than 12,777 plates taken by the Bache, and 6281 by the Boyden telescope. Such a mass of information is likely to yield many discoveries, some of which are given in this volume before us, but to which we cannot adequately refer. This is the case with the discussion of that interesting variable, Nova Normæ, which in nineteen days sprang from a magnitude below visibility to the seventh, and then gradually faded away, passing beyond the reach of the most powerful telescopes in about two years. Comparisons of its spectrum with that of Nova Auriga are given, showing the hydrogen lines bright in both stars, and each accompanied by dark lines of slightly shorter wavelength.

ERNEST HART.

MR. ERNEST HART, editor of the *British Medical Journal*, died on January 7 at Brighton, where he was staying for the benefit of his health. He had suffered from diabetes for many years, and had been compelled to submit to amputation of the leg last September. The operation though successful only postponed the fatal termination of his illness.

Ernest Hart was born in London in 1836, and received his early education at the City of London School during the headmastership of Dr. Mortimer. At school he per-

formed prodigies of prize-winning, and would have taken up a scholarship to Cambridge, in the same year as the late Sir John Seeley, but for the disabilities under which the Jews then lay at the older Universities. He resolved to enter the medical profession, and joined Lane's School, then attached to St. George's Hospital. He became a member of the Royal College of Surgeons in 1856, and after serving the office of Resident Medical Officer of St. Mary's Hospital, was appointed Ophthalmic Surgeon and Lecturer on Ophthalmology at that hospital. Subsequently he became Aural Surgeon also, and for some

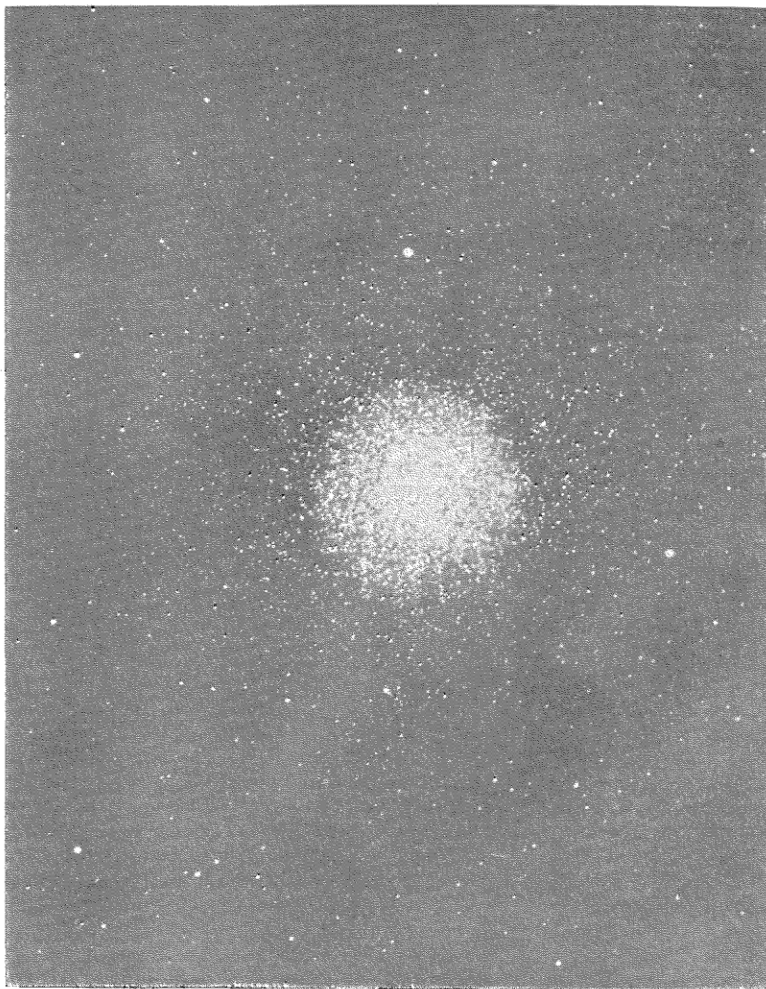


FIG. 2.— ω Centauri.

years held the office of Dean of the Medical School. He was already a valued member of the staff of the *Lancet*, then still directed by its founder, Mr. Thomas Wakley, M.P.; and though he engaged, not without considerable success, in the practice of surgery, and especially of ophthalmic surgery, his heart was in public work. Even as a student he had given evidence of his natural bent by organising a society, to which he acted as secretary, which had for its object to ameliorate the depressing and injurious conditions under which the Naval Medical Service then laboured. This movement was completely successful, as was also another in which he took an active part as one of a commission appointed by the *Lancet* to inquire into the nursing and other arrangements of the poor law infirmaries in London. The